

## SSVEO IFA List

Date:02/27/2003

STS - 51I, OV - 103, Discovery ( 6 )

Time:04:26:PM

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b> Prelaunch	Problem	<b>FIAR</b>	<b>IFA</b> STS-51I-V-01
None	<b>GMT:</b> Prelaunch		<b>SPR</b> 27F001, 27F002	<b>UA</b>
			<b>IPR</b>	<b>PR</b>
				<b>Manager:</b>
				<b>Engineer:</b>

**Title:** BFS Computer Failed Prelaunch. (ORB)

**Summary:** DISCUSSION: Prelaunch at approximately 237:11:06 G.m.t., a BFS GPC 5 IFAIL BITE message was received. The countdown was halted and the initial program load was reinitiated in the BFS machine. The countdown was resumed. At approximately 237:11:42 G.m.t., the BITE message repeated and the launch was scrubbed.

The BFS software was dumped. Analysis of this dump showed there was no anomalous behavior in the BFS Flight Software and failed to provide any data that would isolate a hardware failure. The BFS machine was removed and replaced allowing for a launch two days later. The BFS GPC was tested at KSC and the failure did not repeat. Additional tests were run in the SAIL, at IBM Houston and at IBM/Owego. These tests also failed to repeat the failure. Analysis by Rockwell-Downey BFS engineers discovered 2 altered non-store protected memory locations in the memory dump. Re-executing the program as dumped exactly duplicated the failures. A hardware failure in the GPC is suspected as the cause of the altered memory locations. CONCLUSION: The BFS BITE message was caused by a hardware failure in the GPC which includes the CPU, IOP and cables. All software analyses show the BFS Flight Software to be functioning properly. CORRECTIVE\_ACTION: The BFS GPC was removed and replaced. The replacement machine functioned properly throughout the delayed mission. The failed GPC (CPU, IOP and cables) is undergoing further testing. Reference CAR 27F001 and CAR 27F002. CAR ANALYSIS: Failure symptoms were difficult to repeat despite prolonged testing in an operational environment at SAIL. The most probable cause of failure was noise generated by AMD IC's coupled into the Address Buss lines. This CPU was verified to be sensitive to such noise and had not had the modification designed to prevent the problem. This CPU passed all tests following the modification. EFFECTS\_ON\_SUBSEQUENT\_MISSIONS: NONE

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b> Prelaunch	Problem	<b>FIAR</b>	<b>IFA</b> STS-51I-V-02
				Water and Waste



The hydraulic system accumulator pressure decay is believed to be due to contamination on the seat of the 3-way/unloader valve. The hydraulic system 3 accumulator pressure decay was observed on a previous mission with this vehicle (reference flight problem report STS-51D-06) resulting in continuous circulation pump operation to keep the accumulator pressurized. The accumulator pressure decay ceased after FCS checkout and the 3-way/unloader valve exhibited nominal performance during subsequent ground checkouts and was not removed and replaced. CONCLUSION: The hydraulic system 3 accumulator pressure decay was most probably the result of 3-way/unloader valve contamination which subsequently cleared. CORRECTIVE\_ACTION: The hydraulic system three 3-way/unloader valve will be replaced with a new configuration valve. The failure analysis of the replaced valve will be tracked by CAR 23F001. CAR ANALYSIS: Analysis indicated that the problem was probably caused by contamination that has since passed through the valve. A modified valve has been designed and is authorized, but none are available for replacement. Since the valve problem clears with fluid flow, this valve will be flown-as-is and corrective action will not be taken at this time. EFFECTS\_ON\_SUBSEQUENT\_MISSIONS: NONE

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>		<u>Subsystem</u>
MER - 0	<b>MET:</b>	Problem	<b>FIAR</b>	<b>IFA</b> STS-51I-V-04	OI - Sensors
None	<b>GMT:</b>		<b>SPR</b> A) 24F002, B) 27F006, C) 27F008, D) AC7837 <b>IPR</b>	<b>UA</b> <b>PR</b>	<b>Manager:</b>  <b>Engineer:</b>

**Title:** Instrumentation Failures. (ORB)

**Summary:** DISCUSSION: A. SSME 2 GH2 outlet pressure (V41P1260A) failed during ascent. To conserve spares the measurement is not required for launch commit criteria. It is used for flow control valve evaluation and as a backup measurement to verify engine operation in the event engine data is lost. The sensor will be removed and the sensor port plugged for the next OV-103 flight.

B. SSME 2 LH2 recirculation pump RPM (V41R1215A) failed during prelaunch operations. This pump is operated only during prelaunch and its proper operation can be determined by other measurements. The RPM measurement provides pump life information during spinup and shutdown. The measurement sensor will be replaced when the pump is replaced prior to the next OV-103 flight. C. Fuel cell no. 1 H2 flow (V45R0170A) failed off scale high at approximately 213:07:18 G.m.t. The measurement is not required for launch commit criteria. Fuel cell current, voltage, and performance monitor measurements provide adequate insight into fuel cell performance. The sensor will be replaced when fuel cell removal is necessary. D. APU no. 1 exhaust gas temperature (V46P0142A) failed off scale low during entry. Two EGT measurements are available on each APU and neither is required for launch commit criteria. The sensor will be replaced prior to the next OV-103 flight. CONCLUSION: See above. CORRECTIVE\_ACTION: Measurement failures will be tracked on CAR's (A) 24F002, (B) 27F006, (C) 27F008 and (D) AC7837. CAR ANALYSIS: (THIS SECTION NOT FOUND ON THE PAPER COPY) (B) Pump speed measurement (V41R1215A) problem found in Speed Measurement Signal Conditioner which was replaced. LH2 recirculation pump was operating normally. (C) Flowmeter failure analysis was isolated to a change in heat transfer characteristics of the two sensing elements inside the flow tube. The change was brought about by oxidation caused by the presence of O2 and residual braze flux. This flowmeter was brought into spec by

adjusting two externally adjustable trimmers. The vendor has instituted cleaning procedures for the sensing elements and a burn-in procedure to stabilize elements prior to usage. (D) (Failure transferred from CAR 14F011 to AC7837-010) RI-Downey L&T analysis revealed that the sensor lead wires were twisted and shorted near the transducer exit area. Insulation in the area was also badly frayed. Cause of twisting and insulation damage was attributed to mishandling of the sensor before, during and after installation into the APU exhaust duct. A sensor redesign was submitted by EDCP but was rejected at PMR between Rockwell and NASA.

EFFECTS\_ON\_SUBSEQUENT\_MISSIONS: NONE

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<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b> 000:03:13	Problem	<b>FIAR</b> RMS-1319F	<b>IFA</b> STS-51I-V-05
None	<b>GMT:</b> 239:14:12		<b>SPR</b>	<b>UA</b>
			<b>IPR</b>	<b>PR</b>
				<b>Manager:</b>
				<b>Engineer:</b>

**Title:** Remote Manipulator System Elbow Joint Failed To Respond To Computer Commands In The Primary Mode. (RMS)

**Summary:** DISCUSSION: During RMS (remote manipulator system) operations on flight day 1, the elbow joint failed in the primary mode. The remainder of the required RMS operations for the mission were completed using the back-up mode for the elbow joint and the single, direct drive and back-up modes for the other five joints.

Preliminary on-vehicle postflight tests located two parallel 28 Vdc fuses (5 amp) that were open. Subsequent testing after arm removal showed that a short circuit existed between the 28-volt power and the chassis ground at the elbow servo power amplifier. Further fault isolation at the vendor located a 3/4-inch piece of 22-gage scrap wire between the chassis ground and a power transistor in the elbow servo power amplifier. The piece of scrap wire was removed and components are being analyzed for overstress. CONCLUSION: The RMS elbow joint failed to respond to computer commands in the primary mode because of a short circuit in the elbow servo power amplifier that was caused by a piece of scrap wire. CORRECTIVE\_ACTION: The RMS has been removed and will be replaced. Failure analysis will be tracked on FIAR RMS-1319F. FIAR ANALYSIS: Vendor failure analysis is described under DISCUSSION. Detailed failure analysis methods and results are documented in the NASA-JSC failure reporting system under FIAR RMS-1319F. EFFECTS\_ON\_SUBSEQUENT\_MISSIONS: NONE

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<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b> 000:22:47	Problem	<b>FIAR</b>	<b>IFA</b> STS-51I-V-06
None	<b>GMT:</b> 240:09:46		<b>SPR</b> 27F009	<b>UA</b>
			<b>IPR</b>	<b>PR</b>
				<b>Manager:</b>
				<b>Engineer:</b>

**Title:** Potable Water Nozzle Temperature (V62T0440A) Dropped To 50 Deg F During Supply Water Dump. (ORB)

**Summary:** DISCUSSION: At 240:09:43 G.m.t., during the first supply water dump, the supply nozzle temperature took an unexpected decline indicating a possible freezing condition with the supply water nozzle. It fell below the 90 deg F dump termination temperature limit and the dump was terminated. After two heat-up cycles to 250 deg F a second dump attempt was initiated. The nozzle temeprature started dropping immediately and the dump was again terminated after approximately 45 seconds. The flash evaporator system was used to manage supply water.

At 242:09:07 G.m.t., a supply water dump was again attempted resulting in a nozzle temperature profile similar to previous attempts. The video of the dump indicated a normal spray pattern with no icing. The dump was stopped based on the nozzle termination temperature of 90 deg F. The flash evaporator system was used for the remainder of the mission for supply water management. Postmission the supply water dump nozzle was removed and returned to the contractor for analysis. The analysis identified a leak path through one of the nozzle temperature sensor ports which exposed the temperature sensor to water. The leak rate was less than 0.1 lb/hr of water. The occurrence on other nozzles of water leakage through a nozzle temperature sensor port can be identified by comparing the temperature profiles of the two sensors versus the STS 51-I sensor profiles. The low rate of such a leak (less than 0.1 lb/hr) coupled with the new nozzle orifice altitude chamber testing results verifies that the nozzle can be used to dump water with no ice formation on the nozzle should a leak through a nozzle temperature sensor port occur. **CONCLUSION:** The drop in supply water nozzle temperature was due to a leak path between the brazing material and the nozzle material in the sensor port exposing the sensor to water which evaporated. The water evaporation in the sensor port caused the rapid nozzle temperature decrease. The sensor exposed to water dropped faster than the redundant sensor, reaching a 40 deg F delta at the termination of the three water dumps. **CORRECTIVE\_ACTION:** The nozzle rework procedure at the vendor has been changed to specify the brazing material and to control the brazing environment. The present nozzles are planned to be replaced at a target of opportunity or when the next leakage occurs. **CAR ANALYSIS:** Drop in temperature was caused by a water leak path from the water line to the temp sensor A port. The leak was caused by poor supplier workmanship and poor quality control. The suppliers rework procedure has been modified to eliminate the lack of process controls. All returned hardware will be reworked to the new procedure. (THIS SECTION NOT FOUND ON THE PAPER VERSION) **EFFECTS\_ON\_SUBSEQUENT\_MISSIONS:** NONE

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>	
MER - 0	<b>MET:</b>	Problem	<b>FIAR</b>	<b>IFA</b> STS-51I-V-07	DPS
None	<b>GMT:</b>		<b>SPR</b> None	<b>UA</b>	<b>Manager:</b>
			<b>IPR</b>	<b>PR</b>	<b>Engineer:</b>

**Title:** Annunciator Display Unit Had Blinking Light On The Computer Annunciation Matrix. (ORB)

**Summary:** DISCUSSION: At about 241:07:58 G.m.t., the crew observed that the GPC (general purpose computer) 1-vote-against-GPC 2 lamp on the CAM (computer annunciation matrix) was blinking. The blinking occurred only when GPC 1 issued a "U-fail vote" against GPC 2 and when GPC 2 was powered off. This condition is

indicative of a logic circuit margin problem in the CICU (computer interface conditioning unit). The annunciator lamp check procedure was performed and all other lights responded properly.

The anomaly has been previously observed on OV-103 during ground checkout when the GPC 2-vote-against-GPC 5 CAM light remained on after GPC 5 was powered down. The condition was the result of a circuit-margin problem in the CICU OP-AMP (operational amplifier) circuitry. Using a worst-case analysis, it was determined that the turn-off bias at the OP-AMP, which drives the CAM lamp, is only -32 millivolts. Any combination of changes in the OP-AMP characteristics, GPC ground reference versus the CICU ground reference, capacitive noise coupling in the discrete wiring, or resistance changes can vary the turn-off bias voltage such that the OP-AMP will remain on and thus the CAM lamp will be illuminated. With these circuit margins, the condition can occur in either ground testing or during flight whenever a GPC is powered off and there are fail votes existing from other GPC's. This condition is not flight critical, but rather a nuisance situation which can be reset by an Error Log Reset (SPEC 0) or when an OPS (operations) transition occurs. CONCLUSION: The blinking light on the CAM was the result of a circuit-margin problem within the CICU OP-AMP turn-on/turn-off circuitry. CORRECTIVE\_ACTION: None. Current procedures are adequate. EFFECTS\_ON\_SUBSEQUENT\_MISSIONS: NONE

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>		<u>Subsystem</u>
MER - 0	<b>MET:</b> 000:00:31	Problem	<b>FIAR</b>	<b>IFA</b> STS-51I-V-08	BFS
None	<b>GMT:</b> 239:11:30		<b>SPR</b> None	<b>UA</b>	<b>Manager:</b>
			<b>IPR</b>	<b>PR</b>	
					<b>Engineer:</b>

**Title:** BFS OMS-2 Out-Of-Plane Velocity Computation Was 12.5 FPS Higher Than PASS. (FSW)

**Summary:** DISCUSSION: At approximately 239:11:30 G.m.t., it was observed that the BFS Body Y axis velocity was 12.5 fps higher than the PASS. This difference existed prior, during and post OMS 2 burn.

The first OMS-2 solution was nominal. Due to the launch delay, a new state vector was uplinked at approximately 30 minutes MET and was received correctly by both the PASS and BFS. The crew then reloaded the targets after which the BFS Body Y axis velocity was 12.5 fps higher than PASS. This condition existed until post OMS 2 when the BFS GPC was taken to standby. Rockwell analysis shows that the condition is caused by the BFS flight software implementation of the rendezvous node adjustment for early/late launch times. This implementation recalculated the node when the crew performed the "second" target load after the navigation state vector uplink. CONCLUSION: This occurrence is unique to rendezvous missions that have an early or late launch time which requires a second target load without the GMTLO reference having been adjusted. The current implementation works for a single target load. CORRECTIVE\_ACTION: SMS (Software Modification Sheet) B17009 was written to change the requirements to prevent an incorrect OMS target update with multiple loads. This will be implemented prior to the next rendezvous mission (STS 61-B). EFFECTS\_ON\_SUBSEQUENT\_MISSIONS: NONE

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<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>		<u>Subsystem</u>
MER - 0	<b>MET:</b> 002:06:35	Problem	<b>FIAR</b>	<b>IFA</b> STS-51I-V-09	Active Thermal Control
None	<b>GMT:</b> 241:17:34		<b>SPR</b> AC8418	<b>UA</b>	Subsystem
			<b>IPR</b>	<b>PR</b>	<b>Manager:</b>
					<b>Engineer:</b>

**Title:** Flash Evaporator System Topping Duct Heater B Failed. (ORB)

**Summary:** DISCUSSION: At 241:17:34 G.m.t., heater zone H in FES (flash evaporator system) heater B failed to come on when activated. The topping left duct temperature decreased below the normal minimum thermostat control set point of 151 deg F to 100 deg F. The crew reacted by switching to flash evaporator heater system A and the topping duct temperatures returned to normal for the remainder of the missions.

Troubleshooting at the launch site isolated the problem to an open in a wire splice in the zone H heater circuitry. CONCLUSION: The zone H heater failed because of an open in a wire splice. CORRECTIVE\_ACTION: The wire splice has been repaired and the zone H heater reverified. EFFECTS\_ON\_SUBSEQUENT\_MISSIONS: NONE

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<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>		<u>Subsystem</u>
MER - 0	<b>MET:</b> 003:20:23	Problem	<b>FIAR</b>	<b>IFA</b> STS-51I-V-10	OMS/RCS
None	<b>GMT:</b> 243:07:22		<b>SPR</b> 27F004	<b>UA</b>	<b>Manager:</b>
			<b>IPR</b>	<b>PR</b>	<b>Engineer:</b>

**Title:** Forward Reaction Control System Primary Thruster F1F Deselected. (ORB)

**Summary:** DISCUSSION: At 243:07:22 G.m.t., the forward RCS (reaction control system) primary thruster F1F was deselected by RM (redundancy management) due to low chamber pressure. The primary thrusters must be fired for a minimum cumulative pulse width of 240 milliseconds before the RM will initiate a deselect due to low chamber pressure.

Review of the flight data indicated that at 241:16:58 G.m.t., the F1F thruster was fired for 2 pulses (both 80 milliseconds) with the chamber pressure not responding. Also, data review verified that the F1F thruster was properly commanded to fire and the fuel and oxidizer valve temperatures appeared nominal. Postflight, the F1F thruster chamber pressure measurement responded by tracking the ambient atmospheric pressure. Subsequent postflight pressure testing of the F1F thruster has verified a slow responding chamber pressure measurement which is indicative of a clogged chamber pressure tube. CONCLUSION: The F1F thruster was deselected as a result of a low

indicated chamber pressure caused by a clogged chamber pressure tube. **CORRECTIVE\_ACTION:** The F1F thruster will be repaired at the launch site and reinstalled on OV-103. **CAR ANALYSIS:** Lack of chamber pressure was determined to be contaminants blocking the PC tube. A vendor team has visited the launch site, cleaned the PC tube and replaced the PC sensor. No corrective action is planned because of the history of satisfactory performance of thrusters, tubes and sensors. (THIS SECTION NOT FOUND IN THE PAPER COPY) **EFFECTS\_ON\_SUBSEQUENT\_MISSIONS:** NONE

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<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b> 005:22:03	Problem	<b>FIAR</b>	<b>IFA</b> STS-51I-V-11
None	<b>GMT:</b> 245:09:02		<b>SPR</b> 13F001	<b>UA</b>
			<b>IPR</b>	<b>PR</b>
				<b>Manager:</b>
				<b>Engineer:</b>

**Title:** Right OMS Fuel Tank Isolation Valve Microswitch Failed. (ORB)

**Summary:** DISCUSSION: At about 245:08:58 G.m.t., the right OMS (orbital maneuvering system) fuel tank isolation "A" valve onboard indication was barberpole (miscompare) while the downlink telemetry showed the proper position (open). The MCA (motor control assembly) 1 status 1 indicated that the valve was driving after the valve had reached the open position, and this could only occur if the onboard valve open-position microswitch had failed. The valve control switch was placed in GPC (general purpose computer) to prevent continuous power from being applied to the valve motor. There was no further mission impact.

The right OMS fuel tank isolation "A" valve onboard open-position microswitch failure was first reported during the STS 41-D mission (problem STS-41D-25). In view of system redundancy and the inaccessibility of the microswitch without OMS pod removal, the vehicle was flown with the anomalous microswitch. The problem recurred on STS 51-C (problem STS-51C-15C). Since the right OMS pod will be removed and replaced before the next flight of OV-103, the right OMS fuel tank isolation "A" valve actuator (containing the anomalous microswitch) will be removed and replaced. **CONCLUSION:** The right OMS fuel tank isolation "A" valve onboard open-position failure was most probably caused by a failed or contaminated microswitch. **CORRECTIVE\_ACTION:** The right OMS fuel tank isolation "A" valve actuator (containing the failed microswitch) will be removed, replaced and returned to the vendor for failure analysis. The results of this activity will be tracked via CAR 13F001. **CAR ANALYSIS:** This and many other switch problems is attributed to conductive and nonconductive particles floating within the switch containers in zero G. Problem switches are being replaced as replacement switches (without contaminants) become available. (THIS SECTION IS NOT INCLUDED IN THE PAPER COPY) **EFFECTS\_ON\_SUBSEQUENT\_MISSIONS:** NONE

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<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b>	Problem	<b>FIAR</b> HEN-0043F	<b>IFA</b> STS-51I-V-12
None	<b>GMT:</b> 244:13:23		<b>SPR</b>	<b>UA</b>
			<b>IPR</b>	<b>PR</b>
				<b>Manager:</b>



**Engineer:**

**Title:** Galley Water Did Not Shut Off. (GFE)

**Summary:** DISCUSSION: The crew reported that on flight day 6 the galley water did not shut off until the galley-water supply-line QD (quick disconnect) was disconnected. When the QD was reconnected water flowed until the galley power was cycled to reset the control electronics logic. After the reset, the water dispenser operated normally for the rest of the mission.

A similar problem occurred on the fifth flight of OV-099 with the same galley (serial number 1002) because of a suspected intermittent circuit in the galley control electronics. (See problem STS-41C-25). Although the galley water dispenser system control microswitch assembly was removed from the galley and replaced, extensive component tests and analyses were unable to locate the failure. The galley was reflowed on the sixth flight of OV-099 (STS 41-G) and operated properly throughout the long-duration mission. Failure of the galley water shut off on STS 51-I was probably caused by an intermittent circuit in the galley control electronics. **CONCLUSION:** The galley water shut off failure was probably caused by an intermittent circuit in the galley control electronics. **CORRECTIVE\_ACTION:** The galley was removed and troubleshooting is in progress at JSC. Failure analysis will be tracked on FIAR HEN-0043F. **CAR ANALYSIS:** See discussion under **CORRECTIVE ACTION**. **EFFECTS\_ON\_SUBSEQUENT\_MISSIONS:** NONE

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<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b> 000:11:35	Problem	<b>FIAR</b>	<b>IFA</b> STS-51I-V-13
None	<b>GMT:</b> 239:22:34		<b>SPR</b> None	<b>UA</b>
			<b>IPR</b>	<b>PR</b>

**Engineer:**

**Title:** Right OMS Pod Advanced Felt Reusable Surface Insulation Strip Loose. (ORB)

**Summary:** DISCUSSION: An on-orbit observation indicated an object protruding about 2 inches above the mold line of the right OMS pod. Subsequent inspection during EVA showed the protrusion was the leading edge of an AFRSI (advanced felt reusable surface insulation) blanket on the Y-web door.

Postflight inspection showed no damage to the structure beneath the AFRSI blanket. Inspection also showed the bonding material surface was not uniform in the debonded area. Improper blanket bonding procedure is the most likely cause of the debonding of the blanket to the carrier panel. **CONCLUSION:** The AFRSI blanket peeled back during ascent due to an improper bond at its leading edge. **CORRECTIVE\_ACTION:** Bonding procedures have been changed to require the lay up and application of pressure to be applied within the first half of the pot life of the RTV mixture. In addition, the thickness of the bond application pressure pad will be verified at a greater number of locations to assure uniform pressure over the entire bond surface. **EFFECTS\_ON\_SUBSEQUENT\_MISSIONS:** NONE

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>	
MER - 0	<b>MET:</b>	Problem	<b>FIAR</b>	<b>IFA</b> STS-51I-V-14	Atmospheric
None	<b>GMT:</b>		<b>SPR</b> None	<b>UA</b>	Revitalization Subsystem
			<b>IPR</b>	<b>PR</b>	<b>Manager:</b>
					<b>Engineer:</b>

**Title:** High Partial Pressure Oxygen In Cabin And Oxygen Pressures Tracked Cryogenic Pressures. (ORB)

**Summary:** DISCUSSION: At 240:09:00 G.m.t., when the oxygen bleed orifice was installed, the oxygen partial pressure increased at a faster rate than normal considering metabolic consumption and flow through the orifice. The small oxygen leak disappeared when the bleed orifice valve was closed. The crew initiated troubleshooting procedures and found a leak in the elbow fitting of the bleed orifice. The elbow fitting "B" nut was tightened and the leak was stopped. Intermittently throughout the remainder of the mission, the ECLSS (environmental control and life support system) oxygen manifold pressures tracked the PRSD (power reactant storage and distribution) oxygen cryogenic-tank pressures.

The check valve that isolates the pressurization control system from the oxygen cryogenic tanks functions at about 2 psia or less. During several time periods of zero oxygen flow, the check valve remained partially open due to a balanced pressure condition (low differential pressure across the check valve). This condition allowed the PCS (pressurization control system) manifold pressure to track the PRSD oxygen-tank pressure. The PCS performed nominally throughout the mission. Postflight testing conducted at KSC has verified leakage integrity of PCS 1 and 2 and normal operation of the check valves at all conditions. Previous mission data has shown this same characteristic without any effect on system performance. CONCLUSION: The increase in oxygen partial pressure at a faster-than-normal rate was due to a leak at the bleed orifice elbow fitting. The PCS tracking of the oxygen cryogenic tank pressure was probably due to a balanced pressure condition across the system check valve (low differential pressure across check valve). CORRECTIVE\_ACTION: All oxygen bleed orifices will be returned for verification of the elbow fitting "B" nut torque. EFFECTS\_ON\_SUBSEQUENT\_MISSIONS: NONE

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>	
MER - 0	<b>MET:</b> Prelaunch	Problem	<b>FIAR</b>	<b>IFA</b> STS-51I-V-15	MPS
None	<b>GMT:</b> Prelaunch		<b>SPR</b> 27F013	<b>UA</b>	<b>Manager:</b>
			<b>IPR</b>	<b>PR</b>	<b>Engineer:</b>

**Title:** Space Shuttle Main Engine 1 LH2 Recirculation Pump Ground Power Circuit Breaker Tripped. (ORB)

**Summary:** DISCUSSION: The A.C. (alternating current) power source (three phase) for the main engine LH2 (liquid hydrogen) recirculation pump package (three pumps) is provided by ground motor generators. Each phase of the pump input power is protected by circuit breakers in the motor generators. The LH2 recirculation pumps have no flight operation function and are used only during pre-launch LH2 preconditioning.

During the initial operation of LH2 recirculation pump 1 (LH2 recirculation pump package S/N 5) prior to the launch of STS-51I, the phase A circuit breaker tripped 27 seconds after pump start. This caused the pump to shut down. The pump power circuits were subsequently switched to the secondary, or back-up, motor generator and pump operation was normal for the remainder (9 hours) of the pre-launch LH2 conditioning. The pump also operated normally during the pre-launch LH2 conditioning for the second and third (successful) launch attempts. Postflight troubleshooting did not reveal any anomalies with either the primary ground power supply or with the vehicle LH2 recirculation pump power circuit. It was concluded that a temporary short had occurred in the power circuit at initial turn on. A similar condition occurred with the LH2 recirculation pump package S/N 5 during a prelaunch operation of OV-102. The point of failure was an electrical short from pin to connector case caused by metallic contaminate (6061 aluminum alloy), the most probable source being the pump assembly. The initial failure resulted in improved cleaning procedures for this pump assembly and other pump assemblies subsequently delivered by the supplier. The cleaning procedure was also intended to be used during recycle of any pumps that were found to be drawing excessive current causing circuit breaker trip. **CONCLUSION:** The temporary short circuit in the main engine 1 LH2 recirculation pump was most probably caused by conductive contamination internal to the pump assembly. **CORRECTIVE\_ACTION:** The LH2 recirculation pump package will be replaced and reverified. The faulty LH2 recirculation pump package (S/N 5) will be removed and returned to the vendor for failure analysis. The pump cleaning procedures will also be re-assessed and the results of these activities will be tracked via CAR 27F013. **CAR ANALYSIS:** Unable to determine cause of failure postflight. Same pump ran normally on another motor generator (MG-2) and did not trip breaker. Suspect problem is with MG-1 in the ground equipment. No corrective action is planned. (THIS SECTION IS NOT IN THE PAPER COPY) **EFFECTS\_ON\_SUBSEQUENT\_MISSIONS:** NONE

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<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b> Postlanding	Problem	<b>FIAR</b>	<b>IFA</b> STS-51I-V-16
None	<b>GMT:</b> Postlanding		<b>SPR</b> None	<b>HYD</b>
			<b>IPR</b>	<b>UA</b>
				<b>PR</b>
				<b>Manager:</b>
				<b>Engineer:</b>

**Title:** Oil Seepage In Right Main Landing Gear Well. (ORB)

**Summary:** DISCUSSION: During the postflight inspection, a small quantity of oil was found on the door linkage and on the strut of the right main landing gear. Analysis of the oil determined that the seepage was hydraulic oil. Inspection of the valving module did not locate a leak.

The source of the hydraulic oil seepage in the right main landing gear well is unknown. The small quantity of oil found on the door linkage and on the strut of the right main landing gear may be attributed to normal operation of the landing gear. The hydraulic system will be inspected again for hydraulic oil leakage during ground testing when full hydraulic pressure is applied and cycling of the landing gear isolation valve is possible. **CONCLUSION:** The source of the hydraulic oil seepage in the right main landing gear well is unknown. **CORRECTIVE\_ACTION:** The hydraulic system will be inspected again for hydraulic oil leakage when the system is operated during ground testing prior to the next flight of OV-103. **EFFECTS\_ON\_SUBSEQUENT\_MISSIONS:** NONE

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<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b>	Problem	<b>FIAR</b>	<b>IFA</b> STS-51I-V-17
None	<b>GMT:</b>		<b>SPR</b> 27F010	<b>UA</b>
			<b>IPR</b>	<b>PR</b>
				<b>Manager:</b>
				<b>Engineer:</b>

**Title:** Starboard Payload Bay Door Closed Slowly And Bulkhead Latch Current Was High. (ORB)

**Summary:** DISCUSSION: Prior to entry when the starboard payload bay door was closed, the closing time was approximately 10 seconds longer than the normal dual motor operating time of 56 seconds. Also, the starboard forward and aft bulkhead latch actuators appeared to draw more current than normal.

Postflight troubleshooting verified that the starboard payload bay door closed satisfactorily in normal operating time. Visual inspection of the payload bay door thermal barriers and seals did not indicate any damage or anomalous condition. The increased closing time of the starboard payload bay door and increased bulkhead latch actuator current indicated excessive resistance during the last few degrees of door closure. Probable cause of the increased resistance to door closing was thermal distortion of the vehicle, resulting in a bowed condition (top surface cold, bottom surface warm). No anomalies were detected for the port payload bay door closing which preceded the starboard door closing. A longer-than-normal closing time for a payload bay door has no adverse effect on the mission. Bulkhead latches assist in pulling the doors closed during the last few degrees of closure. If there is difficulty closing payload bay doors during a mission, the vehicle can be thermally conditioned by reorienting relative to the sun. **CONCLUSION:** The starboard payload bay door extended closing time and higher than normal current for the aft and forward bulkhead latch actuators was probably caused by thermal distortion of the vehicle. **CORRECTIVE\_ACTION:** NONE. **CAR ANALYSIS:** Unable to duplicate problem postflight. Suspect that the payload bay doors were cold soaked and the stiff seals caused excessive motor drive time. (THIS SECTION IS NOT IN THE PAPER COPY)  
**EFFECTS\_ON\_SUBSEQUENT\_MISSIONS:** NONE

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<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b> 007:01:12	Problem	<b>FIAR</b>	<b>IFA</b> STS-51I-V-18
None	<b>GMT:</b> 246:12:11		<b>SPR</b> None	<b>UA</b>
			<b>IPR</b>	<b>PR</b>
				<b>Manager:</b>

**Engineer:**

**Title:** The Left OMS Yaw Primary Actuator Failed To Respond. (ORB)

**Summary:** DISCUSSION: During the OMS (orbital maneuvering system) deorbit burn at approximately 246:12:11 G.m.t., the right and left OMS yaw primary actuator responded properly for the first minute and 43 seconds, at which time the left yaw actuator stopped moving. The right OMS yaw primary actuator was sufficient to control the vehicle. There was no other indication of failure of the left yaw actuator.

Postflight data analysis indicated a difference existed in the deadband between the right and left OMS actuator controllers which could account for the different responses between the actuators. The flight data sample rate (once every 200 milli-seconds) does not provide the granularity sufficient to ensure that the deadbands were within specification (plus or minus 0.5 degrees). A slow ramp rate test was performed on the left OMS yaw controller postflight and the actuator deadband was found to be within specification (0.42 to 0.43 degrees) and acceptable for flight. CONCLUSION: Operation of the left OMS actuator during the deorbit burn was nominal.

CORRECTIVE\_ACTION: None warranted. EFFECTS\_ON\_SUBSEQUENT\_MISSIONS: NONE

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<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b> Postlanding	Problem	<b>FIAR</b>	<b>IFA</b> STS-51I-V-19
None	<b>GMT:</b> Postlanding		<b>SPR</b> 27F011	<b>UA</b>
			<b>IPR</b>	<b>PR</b>

**Engineer:**

**Title:** Forward Piece Of The ET Attachment Plate For The Forward ET Separation Bolt Had The Left Forward Bolt Missing. (ORB)

**Summary:** DISCUSSION: The left forward bolt on the ET (external tank) attachment plate was missing when the Orbiter was inspected after landing. The missing bolt was on the forward piece of the ET attachment plate for the forward ET separation bolt. The remaining 7 bolts were reported to have been loose when the ET attachment plate was removed at Dryden. The 8 bolts are 1/4 by 3/4 inches nominal size and they screw into nut plates under the forward monoball bearing plate.

A 43 to 53 inch pound final torque is required to lock the bolts into the nut plates. The bolts and nut plates are replaced after every flight. Tolerance buildup probably resulted in failure of the bolt to fully engage the nut plate locking feature. After STS 51-J, the first flight of OV-104 Atlantis, the breakaway torque on the 8 bolts was measured and found to vary from 2 to 30 inch pounds. Only 1/6 to 1/4 turn was required to torque each bolt back to between 50 and 53 inch pounds. One to 3 1/2 turns then were required to disengage the locking feature of the nut plate and an additional 6 to 7 turns were recorded to disengage each bolt from its nut. CONCLUSION: Loss of the left forward bolt on the two piece ET attachment plate for the forward ET separation bolt was probably caused by failure of the bolt to fully engage the nut plate locking feature. CORRECTIVE\_ACTION: For STS-61A, OV-099 used seven 1/8 inch longer bolts and one bolt 1/6inch longer than the short nominal size bolt. The longer bolts assure full engagement of the nut plate locking feature and dimensional analysis shows that the longer bolts will not bottom out on the orbiter structure. An

approved design fix provides for spot facing or drilling the backface to allow the use of longer bolts. CAR ANALYSIS: Subsequent flights will use MR process to install RCC plate. MCR 11683 will kit all vehicles effective OV-102 flight 8; OV-099 flight 10; OV-103 flight 7; OV-104 flight 2.  
EFFECTS\_ON\_SUBSEQUENT\_MISSIONS: NONE

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